DOCUMENT RESUME

ED 364 577 TM 020 801

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TITLE What Gets Graded Is What Gets Valued.
PUB DATE Apr 93
NOTE 18p.; Paper presented at the Annual Meeting of the American Educational Research Association (Atlanta, GA, April 12-16, 1993). Previously entitled "The Classroom Assessment Practices of Two Mathematics Teachers."
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Algebra; Classroom Techniques; Educational Assessment; Educational Change; Grades (Scholastic); *Grading; High Schools; High School Students; *Mathematics Instruction; Mathematics Teachers; Secondary School Teachers; Student Attitudes; *Student Evaluation; *Teacher Attitudes; Teacher Developed Materials; *Values
IDENTIFIERS *Authentic Assessment; *Performance Based Evaluation

ABSTRACT

The experiences of two mathematics teachers at a high school in which assessment reform is being encouraged are described. The school district had decided that the implementation of authentic assessment and assessment reform would be levers to broaden school reforms. Observations in the Algebra 2 class of one teacher and the Algebra 1 class of another teacher show ways in which authentic assessment is put into practice. Through observing, interviewing, and asking her students to write about their own learning, the Algebra 2 teacher used many authentic assessment approaches. Students, however, did not recognize that they were frequently given writing assignments because these self-evaluations were not included in the grading scheme. The components of authentic assessment were not part of the grading system and were not valued by the students. As the assessment reform movement progresses, this issue of grading systems will become more critical. Grades are a powerful force; they define what it means to know and do mathematics in the classroom. One figure illustrates a sample assessment page. (Contains 8 references.) (SLD)

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What Gets Graded is What Gets Valued

(previous title: The Classroom Assessment Practices of Two Mathematics Teachers)

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Paper prepared for presentation at AERA symposium, *Moving Beyond the Rhetoric About Authentic Assessment in Mathematics*, Atlanta, Georgia, April 14, 1993.

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A major portion of current reforms in mathematics education are devoted to changes in assessment practice, both at the classroom level and on the level of external assessments. Movement away from traditional standardized achievement tests and toward alternative forms of assessment (such as performance assessment, open-ended items, or portfolio assessment) is widespread. According to data collected during 1990, 21 states were implementing or developing alternative assessments in mathematics, and an additional four were exploring or planning such a move. The New Standards Project (Learning Research and Development Center and National Center on Education and the Economy, 1991), whose objective is to create a national examination system in several content areas (including mathematics), claimed membership by 19 "partners" (state departments of education or school districts) in 1991, with half a dozen more expressing an interest in 1992. The system envisioned in the project consists of performance examinations, assessments of student projects, and assessments of portfolios of student work.

In most states, the move to alternative forms of assessment is not an isolated reform effort, but is only one piece of a broader vision. Nevertheless, assessment reform is seen as an essential key to the reform of education. As Wiggins (1989a) expressed it, "The test is the point of leverage--for learning and for reform" (p. 46). The importance of the link between assessment and teaching is also clear in the first principle established at the National Summit on Mathematics Assessment: "the primary purpose of assessment is to improve learning and teaching" (MSEB, 1991, p. 17).

The idea behind assessment reforms is to ultimately improve the education of students. This implies that students are going to have to experience more authentic assessment, not just on nationally standardized tests, but in the classroom as well. Teachers, then, become the key to reform. Little is known, however, about how teachers are interpreting the rhetoric about assessment reform in their own classrooms. In one study conducted during the spring of 1992, I attempted to examine this issue through a case study of a high school mathematics teacher's assessment practices. There were two major foci in that study. The first was a description of all

the ways this teacher assesses what her students know and can do in mathematics, and the second was an examination of the relationship between her beliefs and her assessment practices. In this paper I will discuss one of the findings from that study.

In Ms. League's Algebra 2 class, there were several aspects of assessment that were non-traditional, and were aligned with some of the current rhetoric of authentic assessment. However, these techniques were all but ignored by the students because of one major obstacle: none of these techniques counted towards their grades. The story told here is not a shocking one, but it does provide documentation of how a traditional grading system functioned as a major obstacle to reform in one classroom, so that it ultimately undermined the teacher's more "enlightened" intentions. Let me set the stage for the story by beginning with a brief discussion of the rhetoric of authentic assessment, especially as it was used at this high school.

The Rhetoric About Authentic Assessment

It is important to begin with a working definition of assessment, a term that is often mistakenly confused with testing, measurement, or evaluation. In education, to assess means to describe the current state of a person, within some conceptual, procedural, or developmental domain. When I refer to a teacher's assessment practices, I mean all of the ways that the teacher determines what his/her students know and can do. By contrast, evaluation involves assigning a value to something, testing involves creating a situation that will inform decisions, and measurement involves specifying "how much" of something exists, using some well-specified unit (Lesh & Lamon, 1992).

The term "authentic assessment" arose from the need to distinguish the new ideas of assessment from traditional testing instruments, which often relied on proxies for engaging in a particular discipline. While the term as currently used encompasses a broader range of criteria, the performance assessment aspect of it is still considered to be important. For example, a traditional standardized achievement test might ask the following question: What is the most

appropriate unit of measure for the length of a room: centimeters, meters, or kilometers? A more authentic task might require the student to actually measure the length of the room while the teacher observes. Proponents of authentic assessment have argued that, in order to gain a true assessment of what students know and can do, what is needed is the opportunity for students to engage in the actual performance of work in that discipline.

Archbald and Newmann (1988) consider three criteria to be critical to authentic assessment tasks: 1) Disciplined inquiry; 2) Integration of knowledge; and 3) Value beyond evaluation. Disciplined inquiry refers to the production of new knowledge, such as that created by scientists or historians. It depends on prior conceptual and procedural knowledge, it develops in-depth understanding of a problem, and it "moves beyond knowledge that has been produced by others" (p. 2). Integration of knowledge means that authentic tasks must consider the content as a whole, rather than as a collection of knowledge fragments. Students must "be challenged to understand integrated forms of knowledge," and "be involved in the production, not simply the reproduction, of new knowledge, because this requires knowledge integration" (p.3). Under the third criteria are three features that characterize tasks which possess a value beyond evaluation. These are the production of discourse, things, or performance, the flexible use of time, and collaboration with others.

As an example of an authentic assessment task which meets the criteria they advocate, Archbald and Newmann describe a paper-and-pencil task from the National Assessment of Educational Progress's Pilot Study of Higher-Order Thinking Skills Assessment Techniques in Science and Mathematics. In the task, children are required to examine data about five children competing in three athletic events and decide which of the five would be the all-around winner. This is an example of an "open-ended" task, in that students must devise their own solution strategies and justify their answers, and there is not one "right" answer. In another example of authentic assessment, Archbald and Newmann cite the use of exhibitions of mastery, which are used at some high schools as a requirement for the diploma. Students are required to demonstrate

competence in multiple disciplines, and to produce projects which exhibit the integration of knowledge.

In a similar set of arguments, Wiggins (1989b) calls an assessment technique authentic if it first of all requires "the performance of exemplary tasks" (p. 703) and secondly is "responsive to individual students and to school contexts" (p. 704). Authentic tasks also "reveal achievement on the essentials" (p. 704). Examples of authentic assessment, according to Wiggins, include the portfolio-based assessment program in writing and mathematics being implemented in Vermont, open-ended tasks such as the one described above, and an oral history project.

While the two sets of criteria described above deal with authentic assessment across content areas, several educators have focused more particularly on assessment in mathematics (e.g., Webb & Romberg, 1988; deLange, 1987; Lajoie, 1991). In detailing more specific criteria for assessment in mathematics, most writers echo the more broadly based criteria given by Archbald & Newmann and Wiggins, but make more explicit how the content of mathematics influences the design of assessment tasks.

For example, the Lajoie (1991) criteria for authentic assessment (in an abbreviated form) are:

1. Multiple indications of individual knowledge, performance, and disposition.
2. Tasks are instructionally relevant, meaningful to students, and realistic for the discipline.
3. Scoring and scaling procedures are appropriate to the assessment tasks.
4. Aligned with both curriculum and instruction and shows what students know.
5. Fairly considers racial/ethnic, cultural, gender, and aptitude biases.
6. Integral to the classroom environment.
7. Provides for assessing individual growth within group activities.

Assessment Reform at Valley High

Valley High is a pretty typical small-town American high school. Its 730 students (approximately 95% White) choose from a fairly wide variety of courses from the usual departments of English, mathematics, foreign language, science, art, music, and social studies. The mathematics department offers the usual range of courses, from a general math track to calculus in the college prep track. On the surface, the school appears no different than other middle class American school, yet the winds of change are beginning to blow.

The Valley School District began about two years ago to initiate a series of district-wide reforms. A Strategic Planning Commission, made up of about one-hundred and fifty members of the faculty, administration, school board and community, was constructed and charged with deciding what shape the reform should take. The commission decided that the first, most important, goal for the district would be the implementation of authentic assessment. Their rationale was that assessment reform promised to be the most powerful leverage for broader reforms in the schools.

The school was highlighted as a "school that works" in a television show that focused on assessment, sponsored by the North Central Regional Educational Laboratory. In the show, members of the school board and the principal of the high school present an image of a school system that heartily embraces authentic assessment as one of its central tenets, and is in the midst of reevaluating its curriculum in light of its assessment philosophy.

Some of the changes in the district are being implemented now, while others are still in the planning stages. At the elementary school, teachers have been given the option of using portfolios in place of report cards and grades, and allowances have been made for extended parent-teacher conferences to demonstrate to parents what is in the portfolios. Some of those reports have included the use of videotapes of students at work. The high school, however, is more cautious about eliminating letter grades, though they do have in place a plan for graduation by demonstration of mastery by the year 1996. The goal is to have graduation depend not on

Carnegie units, but on four projects: an autobiography, a thesis, a commencement project, and a portfolio. It is clear that the Valley School District has taken some first steps in the implementation of what looks like an ambitious assessment reform effort.

It was in this setting that Ms. League taught her six mathematics classes in 1991-92. She had been teaching at the high school for five years, after spending some twenty years in the business world and then returning to the university to complete her bachelor's degree in mathematics and her teaching credential. In addition to Algebra 2, she taught geometry and tech math. Because of the overcrowding at the school, Ms. League did not have a classroom of her own, but had to move from room to room for each class, wheeling her teaching materials on a cart.

A personable and caring teacher, Ms. League also likes to think of herself as a "maverick." She endorsed the reforms that were being initiated in the district, and was personally involved in their planning. She was the only representative of the mathematics department on the Strategic Planning Commission for the district, as well as the Gateway Planning Committee, which is directing the graduation program at the high school. While other members of the mathematics department were working to keep the status quo, Ms. League fought to keep mathematics a central part of the new vision, and she also fought to change the textbooks she used to a less-traditional series.

Methodology

I spent approximately three months in the spring of 1992 observing Ms. League's Algebra 2 class. During that time, I was present in the class between two and four days each week, taking field notes. I also observed two of her other classes (geometry and tech math) two times each. In addition, I observed six Algebra 1 classes taught by another teacher in the school, Ms. Torgerson. Each day that I observed, I stayed after the class to have lunch with Ms. League (and occasionally Ms. Torgerson), during which time we had informal discussions about the classes. In addition, I

held four formal interviews with Ms. League and two formal interviews with Ms. Torgerson. I also interviewed ten of the twenty-two students in Ms. League's class, using a group format and three sessions. All of the formal interviews were audiotaped. Both Ms. League and Ms. Torgerson allowed me free access to their grade books and all the student materials they used in their classes.

The Reality of Assessment in the Classroom

It is important to know something about the daily teaching routine in this Algebra 2 class in order to understand some of Ms. League's assessment strategies. The following vignette represents the teaching and learning that took place in this class on an ordinary day.

The lesson begins by Ms. League asking the students if they have any questions from their homework assignment. A few students respond with questions about particular textbook problems. An example of one of those problems is:

Solve each system.

$x^2 - y^2 = 16$

$5x + 3y = -16$ (Sobel et al, 1985, p.349)

The topic is solving linear and quadratic systems of equations. Ms. League demonstrates the solutions to those problems on the blackboard. Doing so takes about twenty minutes.

Ms. League assigns problem number 34 to the students "to try" in their "teaching pairs," which are the prearranged small groups or pairs that always work together when assignments like this are given. Usually members of these groups sit near one another, so they pull their desks closer and get to work. The problem reads:

For what values of k will the line $x = k$ and the hyperbola $25x^2 - 4y^2 = 100$ have 2 points in common? (Sobel et al, 1985, p. 349)

The problem is more abstract and complicated than those they had completed for homework. Ms. League advises them to do it by sketching a graph and "making decisions" from the graph.

As the students work on the problems, Ms. League circulates and gives help where it is needed. At one point she pauses and interrupts their work by saying, "If you're having trouble with this, you need to write down, 'I need to study how to graph hyperbolas.' Be sure to write that down."

Before she demonstrates the solution to the problem, she says, "When I was walking around, I saw all levels of thinking. Some of you were struggling with the graph. Others had trouble with the procedures. Remember that the test is on Friday, and while some of you did OK working together today, remember that on the test you will have to work alone. Be sure you know how much you can do alone before the evaluation on Friday."

They continue working on problems in pairs until the end of class, when Ms. League gives them their homework assignment for the next day (six more similar problems from the textbook). Then she adds, "Your other assignment is to look at what you wrote down today about what you need to do. For example, 'I need to review parabolas.' Do that tonight also."

There are two aspects of this vignette that are especially interesting from an assessment point of view. The first is the observations and interviews that Ms. League routinely has with her students as they work in their teaching pairs, and the second is the emphasis she places on student self-assessment. I would like to discuss each of these in turn.

Because of the use she makes of the "teaching pairs," Ms. League holds a vast amount of knowledge about what her students know and can do in mathematics. While they are working, she interviews them on their work and observes what they do. She takes pride in knowing her students personally, and she can discuss any of her students' strengths and weaknesses at length. During one interview, when she was explaining the marks in her grade book for the current term, I asked her to tell me about a student that I chose at random from the list in the grade book.

Sharon is a very very good student, but she has a lot of problems with

> math. Over the three years I've worked with her she has become more attentive. She used to laugh and talk a lot. She used to think, "I can't do it. It doesn't matter if I try." Her automatic skills are not there. She'll get stuck on skills instead of concepts. She studies and works, so she's able to do well. But she is inconsistent sometimes. After four weeks in the term, we hit conic sections. Sharon is not a visual learner. She took a nosedive and went to a C. I had a conference with her to get her back on track. She wasn't coming in for extra help. At the end of the term, dropping the lowest quiz and computing a raw percentage gave her an 82. I thought this reflected what her mastery of the concepts was. I had a conference with her at the end of the term, which I have with every student. I told her to think about it: You used to think you couldn't do math. Here you are in an advanced class, with an average grade. That made her feel good. I told her mother the same thing. I wanted her to be proud of herself.

This informal method of assessment is not uncommon among high school mathematics teachers, but in the case of Ms. League it is especially well-developed. It is also central to her beliefs about teaching. That is, she believes that knowing her students individually is fundamental to her teaching. Ms. League views this practice of observing and interviewing her students as they work as one of the more "authentic" aspects of her assessment practice. Indeed, according to Lajoie's criteria for authentic assessment, this practice could be seen as part of the "multiple indicators of knowledge."

In the vignette, Ms. League reminded her students to write down in their notebooks remarks to themselves concerning their own strengths and weaknesses as learners. She frequently asked them to write comments to themselves about which concepts they needed more work on, or which procedures they needed to practice. This

emphasis on metacognition, or student self-evaluation, is another aspect of authentic assessment that is common in the literature. Many sources talk about having students keep journals of their own learning, or inviting students to be active participants in the assessment of their learning.

There is another feature of Ms. League's teaching that aligns with some of the rhetoric about reform in mathematics education and reform in classroom assessment. It was not apparent in the vignette, but often during class she would ask the students to respond to higher order thinking questions that go beyond the usual procedural aspects of the lesson. For example, in the first day's lesson on logarithms, she asked the class to think about why there can be no logs of a negative number. When she asked the question, she made it clear that she expected the students to write out a response, complete with an explanation. Sometimes these assignments were to be done in class, and sometimes they were added to the regular homework assignment of textbook problems. It was evident by the frequency of these tasks that Ms. League was a teacher who valued the conceptual knowledge that her students had, not just their ability to carry out algebraic procedures.

In observing, interviewing, and asking her students to write about their own learning and write about mathematical concepts, Ms. League put into practice many of the aspects of authentic assessment. One would expect, then, her students to have had a sense that what was valued in that classroom was not just being able to carry out routine algorithms, but talking and writing about mathematical ideas as well. However, my interviews with the students in the class indicated that such was not the case, as the following excerpt suggests:

LW: Have you ever had to write anything in mathematics class? Write a

paragraph or explain something?

Sara: Yes. A report. I did a report once. That was for extra credit, though.

LW: For what class was that?

Sara: Algebra 1...That was a while ago.

LW: So you never had a situation where a teacher has said, "Here's a problem. Tell me what the answer is. Now explain how you did it."

Sara: Yes. I have had that on a couple of tests before, too. Like--

LW: In this class?

Sara: Well, not this class.

Why is it that the students in this class did not recognize that they were routinely given writing assignments? The answer can be found by looking at the grading system that Ms. League used to evaluate her students. The grades that the students received at the end of each quarter, using a traditional A, B, C scale (90-100 = A etc), were based on the quizzes, tests, and exams that the students took during that term. Homework was checked occasionally, and points given for completion. Homework checks did not include the "extra" assignments about self-evaluations or responses to the higher-order-thinking questions.

The tests and quizzes were written by Ms. League and based entirely on textbook problems. Figure 1 has an example of some test questions:

Insert Figure 1 about here

Typical test questions were identical to the textbook problems assigned for homework, but using different numbers. They were designed to find out if students could carry out the procedures or algorithms they had been doing in class for the previous week or ten days. None of the higher-order-thinking questions, or questions about self-evaluations, were included on those tests or quizzes. Furthermore, all tests and quizzes were done individually, with no collaboration allowed.

In other words, the techniques described above as being components of authentic assessment were not part of the grading system for this class, and the result was that in the students' eyes they were not valued. In fact, the students for the most part ignored any activities that they knew would not "count" towards their grade. On any given day, roughly half of them did not complete their homework. And when Ms. League asked them to do writing assignments in class or for homework, most of them ignored her. Not only did they not do the self-evaluations or answer the higher-order-thinking questions, they did not even recognize that writing was a part of what they did in this class.

For the students, what ultimately counted as worthy of their energy in this class was the tasks or activities that were recorded in the grade book. Other than quizzes, tests, exams, and the occasional homework check, they paid little attention to attempts on Ms. League's part to engage them in any other activities. Many of these other activities would be considered more "authentic" than the procedural questions that constituted the tests and quizzes, but because they were not graded they did not become valued by the students. For the students, what counted as mathematical knowledge was being able to correctly carry out procedures for solving decontextualized problems, such as solving a system of equations. What Ms. League had in mind, with her higher-order questions and her exhortations to think and write and work collaboratively, was a different notion of

these early efforts were in large part a failure. The one critical, but absent, component was an attempt to incorporate any of these efforts into the grading system. From the students' point of view, what counted as knowledge and what warranted their efforts were only those activities that resulted in a number in the grade book. And since none of their collaboration or writing was handled that way, those activities were not valued by the students. What mattered to them was the procedural, textbook questions that appeared on tests and quizzes.

As the assessment reform movement progresses, this issue of grading systems will become more critical. Any serious effort on a teacher's part to employ techniques of authentic assessment in the classroom will have to address the grading issue. Grades, especially at the secondary level, are a powerful force that define what it means to know and do mathematics in a classroom.

From a research perspective, the study from which this paper evolved represents one very small but necessary beginning into our understanding of assessment practices in mathematics classrooms. With all the rhetoric of authentic assessment and the extensive reforms that are being carried out in schools throughout the U.S., there has been very little research done into teachers' assessment practices. While many of the stories may not be shocking or even counter-intuitive (such as the one told here), it is vital that the research community begin to document them, so that our understanding of assessment in the classroom will be broadened and deepened.

what counted as the doing of mathematics. These nontraditional activities had more to do with reasoning, reflecting, and communicating than with carrying out routine procedures. However, since none of those activities were incorporated in the grading system, they were not valued. Thus the expectations for the students were lowered by the grading system that Ms. League had in place.

Ms. League was teaching in a school that has publicly embraced notions of authentic assessment, and has initiated reforms to that end across the district. The principal of the high school is one of the most visible proponents of the reforms, and Ms. League herself was (and is) extensively involved in those efforts. Unlike many of the other members of the mathematics department, she served on several of the key reform committees and was outspoken in her agreement with their cause.

In her own classroom, Ms. League made some attempts to implement some notions of authentic assessment. She worked hard at gathering information about her students through observations and interviews. This information, though it was undocumented, was extensive. She also encouraged her students to reflect on their own mathematical knowledge and write about it. She also offered them opportunities to write about mathematical concepts that went beyond the procedural knowledge of the text. These efforts deserve admiration and applause, for she did all of this under poor working conditions. She taught six classes (about 150 students) in three courses every day without a classroom of her own. She was also constrained severely by the textbook that she relied on for the daily lessons. Without time to do more than occasional supplementing of the text, she was given no assistance by this text for implementing any nontraditional teaching techniques.

While her instincts and initial efforts led her toward more authentic assessment,

Algebra II , Ch. 9 Test Name _____

1. Find the distance between the points (-3, 2) and (5, 1) 1. _____

2. What is the midpoint of the segment in # 1 ? 2. _____

3. Find the distance between the point (-6, -1) and the origin. 3. _____

$$(x-3)^2 + (y+5)^2 = 72$$

4. The above is the equation of a(n) ... 4. _____

5. Its center is at the point ... 5. _____

6. Its radius has a length of ... 6. _____

$$\frac{x^2}{4} - \frac{y^2}{9} = 1$$

7. The above is the equation of a(n) ... 7. _____

8. It's vertices are ... 8. _____

9. It's foci are ... 9. _____

Figure 1 A Sample Page of One Algebra 2 Test

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